Full Abstract Agenda

TUESDAY MARCH 4, 2025

1:00 PM - Bright Ideas for Clean Waters (Yellowjacket Union Great Room)

1:00 PM - Welcome

1:25 PM - Historical St. Louis River Estuary plankton communities and water quality at the Montreal Pier Facility

Michael Nagel*, Lake Superior Research Institute - University of Wisconsin-Superior
Matthew TenEyck, Lake Superior Research Institute - University of Wisconsin-Superior
Payton Kittaka, Lake Superior Research Institute - University of Wisconsin-Superior

Since 2008, the Lake Superior Research Institute has collected water quality measurements and biological samples incidental to the evaluation of ballast water management systems at the Montreal Pier Ballast Testing Facility in the St. Louis River Estuary.

Zooplankton, phytoplankton, total suspended solids, and dissolved organic carbon samples were collected throughout seasonal testing at the facility during periods of no ice cover, roughly April to November, with varying degrees of frequency throughout the years.

This presentation will discuss the preliminary long-term trends in water quality, organism phenology, and invasive species abundance that were observed as this data is examined in its entirety for the first time. Climate and weather, particularly the record warm and largely ice-free winter of 2023-24, will be examined as potential drivers of recent observations.

We hope to have these records publicly available on our ArcGIS database in the near future as we continue to collect this data.

Keywords: monitoring, zooplankton, phytoplankton, water quality

1:45 PM - Accuracy of Rapid Test Strips for the Detection of the Cyanotoxin Microcystin-LR

Janae Widiker*, Lake Superior National Estuarine Research Reserve, University of Wisconsin-Madison Division of Extension
Kaitlin Reinl, Lake Superior National Estuarine Research Reserve, University of Wisconsin-Madison Division of Extension

Harmful Algal Blooms (HABs) pose significant risks to water quality, public health, and aquatic ecosystems, particularly in the Great Lakes.

While blooms characteristically occur in eutrophic waters due to their high nutrient content essential for algal growth, there is growing concern about blooms in oligotrophic waters such as Lake Superior. This concern is particularly relevant for the St. Louis River Estuary, a vital ecosystem that serves as a transition zone between Lake Superior and its tributaries. Despite its importance, limited information is available on how blooms behave in these nutrient-poor environments.

Traditional methods for detecting microcystin, a common cyanotoxin, are often time-consuming, making it challenging to effectively manage risks to public health posed by HABs. While some rapid tests are available, their accuracy is not well known. In this study, we evaluated the accuracy of two brands of Microcystin-LR field test strips, Gold Standard Diagnostics and 5Strands, under different water quality conditions of natural water samples from various locations in the St. Louis River Estuary and concentrations ranging from 1 µg/L to 15 µg/L.

Preliminary results show that both brands were able to detect Microcystin-LR under a wide range of water quality conditions and at concentrations above the EPA Recreation limit for Microcystin of 8 µg/L. These findings will provide valuable insights for environmental monitoring programs in the St. Louis River Estuary, contributing to fast and reliable protection of its water resources and the public health of surrounding communities.

Keywords: harmful algal blooms (HABs), microcystin-LR, water quality, rapid test strips

2:05 PM - Predicting total phosphorus level in streams over north shore of Lake Superior using hybrid machine learning model

Amit Kumar*, Department of Civil Engineering, University of Minnesota Duluth, MN
Kun Zhang Department of Civil Engineering, University of Minnesota Duluth, MN

Cyanobacterial blooms have been observed in Lake Superior since 2012, and the frequency and intensity have increased. Blooms of Cyanobacteria are often associated with increased nutrient loads from watersheds and phosphorus is generally considered to be the primary limiting nutrient.

To better preserve Lake Superior, significant resources have been put into the water quality monitoring and sampling in lakes and streams, including the St. Louis River. However, it is not cost-effective or even practical to measure nutrients across numerous aquatic ecosystems at the frequency required to protect our treasured streams and lakes.

Monitoring phosphorus in situ is particularly challenging because a very low phosphorus concentration (e.g., 0.01 mg/L) can be harmful. Machine learning (ML) models provide a cost-effective, transferable approach to predict the concentrations and loads of phosphorus in streams based on low-dimensional patterns observed from conventional water quality parameters that are easier to obtain.

This study develops an explainable hybrid machine learning framework to predict total phosphorus levels using various water quality parameters (DO, conductivity, turbidity, transparency, streamflow, and TSS). The framework integrates probabilistic principal component analysis (P2CA) with multiple explainable machine learning models, such as Bagging Ensemble Learning, Boosting Ensemble Learning, Gaussian Process Regression, and Support Vector Regression, to improve prediction accuracy.

Results reveal that the hybrid P2CA-Boosting Ensemble Learning model consistently outperforms other approaches. With measurements in Amity Creek, the model can effectively predict the concentration of total phosphorus in both Amity and Kingsbury Creeks based on solely conventional water quality parameters. This study underscores the effectiveness of combining P2CA with Boosting Ensemble Learning for accurate and reliable total phosphorus prediction, providing a valuable computational tool for water quality management in the St. Louis River and other streams in the north shore.

Keywords: cyanobacterial blooms, water quality prediction, machine learning, Lake Superior, St. Louis River

2:25 PM - Working in Partnership to Improve the Understanding of Water Quality Along Lake Superior's Wisconsin Coastline

Sam Blackburn*, Center for Limnology, University of Wisconsin-Madison
Kait Reinl, Lake Superior National Estuarine Research Reserve
Ellen Coffman, Wisconsin Department of Natural Resources
Brenda Lafrancois, National Park Service
Matt Hudson, Mary Griggs Burke Center for Freshwater Innovation, Northland College
Hilary Dugan, University of Wisconsin - Madison Center for Limnology

Cyanobacterial blooms are one of the most significant management challenges in the Great Lakes today, particularly due to their ability to produce liver and neurotoxins, creating a major public health threat.

Lake Superior has experienced intermittent blooms since 2012, and blooms have been observed in Lake Superior and the St. Louis River Estuary almost every year since 2016. A number of these blooms were toxic, occurring at popular public beaches such as Barker's Island and Wisconsin Point beaches in Superior, WI.

The Lake Superior National Estuarine Research Reserve and regional partners have collaboratively collected monitoring data along the Wisconsin coastline of Lake Superior and connecting tributaries on and off since 2015. Datasets include discrete water quality samples (e.g., nutrients, chlorophyll-a, phycocyanin, total suspended solids) and continuous data collected via sensors (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, chlorophyll-a).

Data were analyzed to determine the optimal number of sites and frequency of sampling needed to capture trends in nearshore conditions and bloom dynamics and optimize monitoring efficiency (cost and time). This analysis will be implemented in the monitoring strategy used by project partners in 2025.

By coordinating the data management and sampling efforts of partners, this work will lead to a collaborative response to nutrients and blooms in Lake Superior waters, informed decisions about how to prioritize future monitoring, and better supported human-nature relationships by addressing emerging ecological and public health issues impacting local communities.

Keywords: harmful algal blooms, nutrients, monitoring

2:40 PM - 3:00 PM - BREAK

3:00 PM - Bright Ideas for Clean Waters (YU Great Room)

3:00 PM - Evaluation of Ballast Water Management Systems on Great Lakes Vessels

Nathan Schwartz*, Lake Superior Research Institute

As one the largest inland ports in North America, a multitude of ships transport cargo from the port of Duluth-Superior every year. When acquiring cargo, these ships empty billions of gallons of ballast water into its watershed.

In a regional effort to prevent ship-mediated introduction of aquatic nuisance species (ANS) in the Great Lakes-St. Lawrence Seaway System, the Great Waters Research Collaborative (GWRC) has been conducting shipboard evaluations of International Maritime Organization (IMO) and U.S. Coast Guard type approved ballast water management systems (BWMS) to determine if these systems can treat Great Lakes ballast water effectively to provide a high level of organism reduction, including reduction of ANS taxa.

There are five vessels in the research program, each of which utilize a different BWMS or BWMS component. GWRC researchers conduct paired sampling of ballast uptake and discharge operations during which they board the vessel and collect biological and chemical samples.

Biological samples include organisms within the three regulated size classes of organisms in ballast water discharge, ≥ 50 µm (nominally zooplankton), ≥ 10 and < 50 µm (nominally protists), and the indicator microbes Escherichia coli, Enterococci spp., and Vibrio cholerae (serogroups O1 and O139). Chemical parameters include temperature, pH, conductivity, turbidity, chlorophyll, total suspended solids, organic carbon, and ultraviolet transmittance at 254 nm. Testing occurs in multiple ports, including Duluth-Superior, throughout the shipping season to provide spatial and temporal data for the BWMS.

Initial data analysis indicates treatment effectiveness varies based on the type of BWMS and port water quality.

Keywords: ballast, ANS, water quality

3:20 PM - The Great Lakes Port Conditions Database: A Tool for Effective Ballast Water Management

Gwendolyn Ough*, Lake Superior Research Institute
Margaret Brown, Lake Superior Research Institute

The Port of Duluth-Superior, located within the St. Louis River estuary, is consistently ranked among the busiest shipping ports on the Great Lakes, receiving about 85% of ballast water discharges in the Great Lakes system.

More than 180 species of plants, plankton, fish, and pathogens have been introduced to the Great Lakes, most of which arrived by ballast water. To prevent further nonnative species introductions, ballast water management systems (BWMS) have been developed and implemented globally, and more recently in the Great Lakes.

However, the effectiveness of a BWMS is heavily influenced by water quality. Effectiveness in terms of BWMS can be viewed in two ways: biological effectiveness, relating to the ability of the system to treat water to discharge standards, and operational effectiveness, meaning the capacity of the BWMS to be implemented seamlessly into Great Lakes shipping without impacting economic activities, such as cargo operations. Ensuring BWMS are both biologically and operationally effective encourage their use, thus preventing the introduction of new non-native species.

Ultimately, the goal of this project is to create a publicly available database of Great Lakes port conditions that shipping companies can utilize to identify the best available BWMS for their needs and developers can design systems to meet the challenge conditions present. The creation of this database includes quarterly collection of chemical and biological parameters at the top 24 ballast uptake ports.

This presentation will examine the effects water quality has on BWMS effectiveness. Further, we will demonstrate the Great Lakes Port Conditions database, review methodologies of data collection, and discuss the usefulness of this tool for the shipping industry and beyond.

Keywords: ballast, ANS, water quality, database

3:35 PM - Appreciating the Whole: Including the Dark Night Sky Above Us - Avian Night Sky Paintings and Poems

Stephen Wilbers*, University of Minnesota, Starry Skies North, DarkSky Wisconsin, Friends of the Eau Claire Lakes Area

I propose reading three short poems titled “Alphabet of the Trees,” “Choices,” and “Hello to Summer: A Poem in Two Parts,” whose two parts are “Crunching Down a Dark Gravel Lane on a Moonless Summer Night” and “Without Conscious Thought.” I wrote these and other poems (published in the catalog of the June 21-July 5 exhibition at the Schmidt Artist Lofts in St. Paul) to illustrate the paintings of MaryBeth Garrigan and Petra Johnita Lommen. While reading my three poems, I will project both poems and paintings, followed by a two-minute slide show of some of the other exhibition paintings and, including my shaped and animated poem, “Missing You,” whose outstretched word-wings (composed of a repeated 21-word refrain) dance beside Garrigan and Lommen’s painting, “Corvus Minor.”

The themes of our artistic collaboration are the need to live sustainably, the threats to our avian relatives posed by light pollution and climate change, the beauty and mystery of our dark night sky, and the need to protect it. To further illustrate our collaboration, I will display a large poem panel of my poem, “Alphabet of the Trees,” whose lines literally point toward Garrigan and Lommen’s painting, “Whispers of the North.” After reading that poem’s concluding stanza, “Now find one dark reproachful eye / beneath a crossing bar of

swollen limbs, / hidden yet illumined behind those gray letters. / Look, they say. And sing with us our winter song," I will ask attendees if they can find the hidden eye in the painting.

To further illustrate our collaboration, I will display one or two of Garrigan and Lommen's original paintings, including Lommen's stunning "Jingle Dress Starscape," painted while Lommen was working as the Science Museum of Minneapolis Paleontology Hall floor supervisor after coming upon a group of Ojibwe dancers whose sound led her to see the relation between sound and stars in a new way.

PDF copies of our exhibition brochure will be emailed to anyone donating $10 via Venmo to Starry Skies North. A limited number of hard copies will be offered for sale, with proceeds also going to Starry Skies North.

Keywords: avian, night, migrations, dark, skies

3:50 PM - Transition to Poster & Art Session

4:00 - 6:00 PM - Poster and Art Session (Yellowjacket Union Atrium)
**Poster and art abstracts listed at the end of this document.*

WEDNESDAY MARCH 5, 2025

9:00 AM - Welcome and Keynote (Yellowjacket Union Great Room)

9:00 AM - Remarks from Patrick Robinson, University of Wisconsin-Madison Division of Extension Associate Dean of Agriculture, Natural Resources & Community Development

9:05 AM - KEYNOTE PRESENTATION

Water, We Respect You: Tribal Sovereignty in the watershed of Chigami-ziibi

Presenter and panelists include:
Nancy Schuldt*, Water Projects Coordinator of the Fond du Lac Band of Lake Superior Chippewa
Thomas Howes, Natural Resources Manager of the Fond du Lac Band of Lake Superior Chippewa
Darren Vogt, Resource Management Division Director at the 1854 Treaty Authority
Jason Schlender, Executive Administrator at the Great Lakes Indian Fish & Wildlife Commission
Joseph Bauerkemper, Director of the Tribal Sovereignty Institute at University of Minnesota Duluth.

Chigami-ziibi (the St. Louis River) sprawls across the Ceded Territory of Ojibwe people and forms the eastern border of the Fond du Lac Reservation. Treaty rights and the efforts of Tribal Nations staff have played a central role in stewarding the river and the estuary, from the restoration of name (nah-meh, lake sturgeon) and manoomin (wild rice) to the Area of Concern delisting process to water quality protection.

These efforts are underpinned by Indigenous Knowledge and by sovereignty, the authority to self-govern in order to protect and enhance the health, safety, and welfare of tribal citizens. As the river heals and faces a mosaic of new challenges, how can Tribal Sovereignty illuminate ways we can all care for the river?

10:30-10:45 AM - BREAK

10:45 AM - AOC Advances: Restoring Connections and Revitalizing Waterways (YU Great Room)

10:45 AM - Lest We Forget

Grace Leppink-Walz*, Fond du Lac Band of Lake Superior Chippewa Resources Management
Tyler Kasper*, Minnesota Department of Natural Resources
Barb Huberty*, Minnesota Pollution Control Agency
Matt Steiger*, Wisconsin Department of Natural Resources

When the St. Louis River conditions were at their worst, it may have been difficult to envision a recovered river. People that see the river today may have difficulty understanding just how degraded it was.

Our recent focus has been on 50 years of new laws, treatment processes, habitat restoration, and contaminated sediment remediation to catalyze the river's recovery. But it is also important to keep ahold of the past, so people understand how bad it was and how far we've come. To paint the historical picture, I will share memories submitted by people that experienced the river before the 1970's.

Keywords: history, memories, degraded river

11:05 AM - St. Louis River Area of Concern Annual Progress Update

Matt Steiger*, Wisconsin Department of Natural Resources
Barb Huberty, Minnesota Pollution Control Agency
Tyler Kasper, Minnesota Department of Natural Resources
Grace Leppink-Walz, Fond du Lac Band of Lake Superior Chippewa

Implementation of the St. Louis River Area of Concern Remedial Action Plan continues to make progress toward delisting. Nearly 80% of the defined management actions are complete and four of nine Beneficial Use Impairments have been removed. This presentation will highlight what work has been done since the last Summit, along with planned 2025 work and milestones. The strategy for completing remaining work, removing Beneficial Use Impairments, and delisting the St. Louis River Area of Concern will be shared.

Keywords: area of concern, delisting, remedial action plan

11:25 AM - Waterway Benefits Study Recommendations: Centering Reconnection

Molly Wick*, University of Minnesota Duluth, US EPA Great Lakes Toxicology and Ecology Division
Lucinda Johnson, University of Minnesota Duluth
Ryan Bergstrom, University of Minnesota Duluth
Joel Hoffman, US EPA Great Lakes Toxicology and Ecology Division
Deanna Erickson, Lake Superior National Estuarine Research Reserve

The Great Lakes Area of Concern (AOC) program was established to address Beneficial Use Impairments (BUIs) in aquatic ecosystems caused by historic anthropogenic degradation and habitat loss. The "R2R2R3" paradigm highlights the potential impacts that AOC program actions can have for their communities: environmental Remediation can facilitate ecosystem Restoration, which can spur community Revitalization.

In the Waterway Benefits Study in the St. Louis River Estuary, we explored the benefits from and barriers to waterfront experiences by conducting a survey of 532 residents and semi-structured interviews with 42 participants. In short answer responses, participants identified the need for a healthy environment, along with needs for access to the water, universally accessible amenities, public communication and education about environmental conditions, skills building, and opportunities to deepen relationships with waterfront places.

Our results suggest that remediation and restoration activities must be paired with actions to support connection between the community and waterfront spaces to facilitate potential human well-being benefits (and therefore, revitalization outcomes). These results support funding for and prioritization of access, amenities, communication, and education to amplify and support existing relationships with water and reconnect communities with waterfront ecosystems. Reconnection can be considered an additional "R" to the paradigm: Remediation and Restoration, paired with Reconnection, can lead to community Revitalization.

Only through explicit reconnection efforts can BUIs be fully addressed in a way that achieves realized human well-being benefits for the community.

11:40 AM - New Opportunities for River Connections: Public Access Improvements in the Wake of River Restoration

Allison Brooks*, City of Duluth Parks and Recreation
Cliff Knettel, City of Duluth
Peter Ray, City of Duluth
Chris Morgan, National Park Service

After decades of separation, new opportunities have emerged to address the physical, cultural, and sociohistorical barriers to accessing the St. Louis River in West Duluth. Significant collaboration between government, nonprofit, and private organizations has led to extensive river restoration.

The City of Duluth embarked on an extensive planning and community engagement process along the river corridor in preparation for the eventual delisting of the St. Louis River Area of Concern. Successful community engagement has resulted in the designation of the St. Louis River Estuary National Water Trail and Waabizheshikana: The Marten Trail, formerly known as the Western Waterfront Trail.

In partnership with the National Park Service, the City of Duluth aims to shift the narrative for future generations by creating new and improved opportunities for outdoor recreation and environmental stewardship. This presentation will share the ways that we are seeking to address barriers through new infrastructure and increased capacity for river-centric programming.

New infrastructure will include constructing segments of Waabizheshikana and completing trailhead improvements to serve the National Water Trail and Waabizheshikana. Infrastructure will be complemented by the implementation of the interpretive plan to share the cultural and industrial histories of the estuary.

Infrastructure will be intentionally designed, located at multiple sites along the St. Louis River, and provide opportunities for hiking, biking, paddling, and fishing. New programming focuses on activating these river spaces through recreation activities such as fishing, birding, canoeing, and family focused programs.

The City has also partnered with the St. Louis River Alliance to provide joint programming aimed at lowering barriers for river adjacent communities to cultivate a strong sense of connectedness back to the river. In combination, these efforts aim to create new and meaningful connections for folks to explore on, in, and along the St. Louis River.

Keywords: collaboration, Infrastructure, recreation, community engagement

12:00 -1:15 PM - LUNCH in the YU Great Room, with optional concurrent events

Career Session for Students: Learning from Each Other (YU Room 204)
Students are invited to attend this free workshop at the St. Louis River Summit.
At this event, you will:

- Share your experiences and learn from others'
- Discuss and work on job search elements like skills beyond school, resume preparation, & taking care during the search
- Hear from professionals in land and water careers

Legislative Listening Session hosted by FOLSR (YU Room 202)
The Legislative Listening session is a chance for Summit attendees to interact with regional staff of our elected officials in Washington, D.C. We've invited representatives for Senators Baldwin, Johnson, Klobuchar and Smith, and U.S. Representatives Stauber and Tiffany. Grab your lunch and head to the session. After introductions by each staff person, we will informally go around the room and allow each attendee to describe to the legislative staff how federal funding has benefited the region, and how sustaining, or even growing funding, will help us do more. We've encouraged our guests to ask you questions as well. They will then take what they learned to their respective elected officials.

1:15pm - Watershed Wisdom: Collaboration, Governance, and Sustainability in Action (YU Great Room)

1:15 PM - Course-Based Research Provides Coastal Insights Through Collaborative Science and Big Data Skills

Kait Reinl*, Lake Superior National Estuarine Research Reserve, University of Wisconsin-Madison Division of Extension
Paul Hanson*, Center for Limnology, University of Wisconsin -Madison
Sylvia Yang, Padilla Bay National Estuarine Research Reserve, Washington State Department of Ecology

The National Estuarine Research Reserve (NERR) System-Wide Monitoring Program (SWMP) is a long-term environmental monitoring initiative that collects consistent water quality, weather, and biological data from estuaries across the United States to support informed coastal management and research.

The SWMP provides an opportunity to compare spatiotemporal dynamics across a wide range of estuaries in the nation to discover patterns and trends in ecosystem dynamics. Yet, limited personnel capacity has meant that these datasets have not been fully utilized. To address this need, the Lake Superior NERR co-developed a graduate-level class at the University of Wisconsin-Madison for Spring 2024 with dual learning objectives: a technical objective of learning big ecological data skills and a collaborative objective of conducting end user-driven collaborative science.

Student groups worked with a NERR throughout the semester to address specific science and/or management needs related to coastal ecosystems and estuaries using SWMP data. During the class, students learned about coastal ecosystems and estuarine environments, how to wrangle big ecological datasets and conduct complex time series analyses, and how to do collaborative science centered around end-user engagement from beginning to end.

In this talk, we share our journey of developing and implementing this class, highlight student findings, and discuss successes and lessons learned along the way. We will also share how this model is being continued to help serve the data analysis needs of the Twin Ports and regional communities.

Keywords: NERR, SWMP, data science, collaborative, students

1:35 PM - A Watershed Approach to Co-Creating Just Sustainabilities: Reflections from the Lake Superior Living Labs Network

Rachel Portinga*, Lake Superior Living Labs Network & Lakehead University
Nairne Cameron, Algoma University
Erika Vye, Michigan Technological University
Courtney Vaughan, Lakehead University & Conversations in Canoes

Living labs aim to co-create innovative solutions to complex challenges through interdisciplinary, placed-based experiential learning and community-engaged action in the built and natural environments. Established in 2018, the Lake Superior Living Labs Network (LSLLN) is a nested network of living labs collaborating across the Lake Superior watershed connecting academics and community groups in Canada, the United States and multiple Indigenous territories. The LSLLN's goal is to facilitate, develop, expand, and uplift partnerships and place-based collaborative initiatives grounded in the Lake Superior watershed as a social-ecological system. Our research, teaching, and action projects occur at various intersections of food, water, land, energy, climate, community wellbeing, and social justice. Our presentation will share highlights from our collective watershed scale projects, lessons learned about a living lab approach, and their potential to establish connections and increase the impact of place-based activities focused on social and environmental justice and sustainability. Finally, we will draw connections between the St. Louis River watershed as one piece of the whole Lake Superior watershed.
See: www.livinglabsnetwork.org

Keywords: living labs, community-engaged action, environmental justice, watershed networks, just sustainabilities

1:50 PM - Tackling watershed wide issues with local efforts: A St Louis River One Watershed One Plan in action

Andy Kasun*, South St. Louis Soil and Water Conservation District
Kyle Hildebrandt, South St. Louis Soil and Water Conservation District

Managing the vast and diverse St. Louis River watershed poses significant challenges, requiring coordinated efforts to address complex issues across its landscapes. The St. Louis River One Watershed One Plan (1W1P) provides a collaborative framework to tackle these challenges through goals focused on surface water quality, drinking water protection, land use, altered hydrology, and habitat restoration.

The South St. Louis SWCD and its partners are beginning the implementation efforts, with an emphasis on priority watersheds like Keene Creek and urban water quality work in Duluth. Efforts over the next decade will aim to reduce impairments, restore natural hydrology, and improve and protect valuable habitat. These coordinated local efforts will in turn benefit the restoration and preservation of the broader watershed and estuary stewardship.

Keywords: watershed planning, restoration, impairments, habitat, hydrology

2:05 - 2:20 PM - BREAK

2:20 PM - Watershed Wisdom: Collaboration, Governance, and Sustainability in Action (YU Great Room)

2:20 PM Ripple effects: Examining the mosaics of governance structures in three Great Lakes Restoration Initiative projects

Meghan Klasic*, U.S. Environmental Protection Agency, Office of Research and Development, Great Lakes Toxicology and Ecology Division
Katie Williams, U.S. Environmental Protection Agency, Office of Research and Development, Great Lakes Toxicology and Ecology Division

More than $3 billion dollars have been poured into remediating and restoring contaminated waters and sediments across the Great Lakes region, including in the St. Louis River Area of Concern.

Implementation of remediation and restoration are made possible through a complex mosaic of partners across multiple levels of governance, representing diverse perspectives, priorities, and resources, contributing to comprehensive, collective effort.

To better understand how these pieces create a cohesive whole, we ask: How do these governance networks vary across projects, how do they adapt over phases of the projects, and which structures lead to improved social-ecological outcomes? We explore these questions through a study of three AOCs: St. Louis River, Cuyahoga, and Milwaukee. Drawing on planning and policy documents, participant observation at public meetings, and interviews with key partners, we construct governance networks to understand how specific projects contribute to AOC goals. Combining governance networks with qualitative details, we examine which entities lead oversight, engineering, communications, and research efforts in each of the AOC projects, and how the networks of entity relationships are designed to address remediation, restoration, and revitalization (R2R2R) concerns.

Overall, we find different partners leading R2R2R efforts across projects, highlighting the critical roles that local context and leadership plays in social-ecological project success. Future work will examine how these governance networks adapt and change over time as partners navigate the different phases of R2R2R.

Keywords: governance, social-ecological outcomes, R2R2R, networks, restoration

2:40 PM - Sustaining Namāēw: partner-led climate adaptation for Indigenous fisheries in the Great Lakes

Holly Embke*, United States Geological Survey
Rob Croll, Great Lakes Indian Wildlife Commission

Namāēw (Menominee; Name, Ojibwe; lake sturgeon Acipenser fulvescens) have been a foundation of Indigenous culture and nutritional sovereignty for centuries. But in the Laurentian Great Lakes region (hereafter Great Lakes), namāēw have declined more than 80% due to overharvest and dams, leaving them sensitive to climate change.

Following a call-to-action from Indigenous leaders, we initiated a partnership-driven effort to (1) assess climate change impacts on namāēw; and (2) develop potential adaptation options for namāēw. We developed a participatory, transdisciplinary approach to combine multiple ways of knowing and two-eyed seeing. We used a literature review along with nine semi-structured conversations with officials from Indigenous Nations and organizations in the Great Lakes.

Prominent themes were identified using template analysis. Top concerns focused on access, culture, and fish persistence, with all conversations highlighting these themes. Other concerns included climate impacts, food web shifts, habitat availability, non-climate stressors, and water quality. The most prominent adaptation themes focused on population assessments, stocking, harvest regulations, habitat restoration, interagency coordination, cultural advocacy, and partnership; these themes highlight key opportunities to support Indigenous fisheries in the Great Lakes.

Partnership-driven research approaches are critical to supporting multiple ways of knowing, co-production of knowledge, and equitable adaptation outcomes. Our approach and findings can be used to inform future research avenues and stewardship planning for fisheries experiencing global change.

Keywords: fisheries, climate adaptation, participatory research, Tribal engagement

3:00 PM - Activating a Community of Lake Superior Educators

Luciana Ranelli*, Lake Superior National Estuarine Research Reserve
Sue Correll*, Cooper Elementary School, Superior, WI

Join us for recent celebrations of the Rivers2Lake Education Program shared from two perspectives: teacher and program coordinator.

Rivers2Lake provides mentorship and resources to educators to support implementing interdisciplinary, inquiry-based, outdoor learning using the Lake Superior watershed as a foundation. Currently, the Rivers2Lake program is working to create a community of practice among teacher alumni of the program.

Come hear about how we're engaging and activating this community.

Keywords: education, teachers

3:15 - 3:30 PM - BREAK - *Transition to* ***Networking Sessions***

3:30 PM - Networking Sessions – held concurrently from 3:30-5:00 PM

3:30-5:00 PM Network Sessions (Concurrent)

- **Bridging Science and Education: Developing Data-Driven Lessons for Classrooms** (Swenson 1058)
  Erik Johnson, Western Lake Superior Sanitary District

  This session will provide a platform for St. Louis River Summit participants to collaborate and brainstorm ideas for creating educational activities that relate to the research happening near the St. Louis River. The goal is to draft a series of classroom-ready lessons about the St. Louis River along the lines of Data Nuggets – a lesson model developed at Michigan State University that brings authentic research and datasets into K-16 classrooms.

  During the session, educators and scientists will work collaboratively to identify key aspects of research—such as data trends, ecological findings, and restoration efforts—that can be transformed into engaging, data-driven educational materials. By focusing on the St. Louis River's unique ecology and environmental challenges, these lessons will provide educators with tools to teach core scientific practices like hypothesis testing, data analysis, and evidence-based reasoning while building students' quantitative literacy and environmental awareness.

  Participants will explore how to make their research accessible and relevant to a diverse student audience and outline potential lesson structures similar to a Data Nuggets format. Ideas generated during the session will form the foundation for a series of pilot lessons, with the ultimate goal of providing educators with authentic, local data they can use to connect students with the science happening around the St. Louis River.

  This session will offer a unique opportunity to foster interdisciplinary collaboration, promote public understanding of the St. Louis River, and support the next generation of environmental stewards. Scientists and educators interested in bridging the gap between research and education are encouraged to attend and contribute to this innovative initiative.

- **Collaborative Use of Educational and Research Vessels in the Twin Ports** (YU Room 202)
  Alan Brew, Lake Superior Research Institute, UW-Superior
  Amy Eliot, Lake Superior Research Institute, UW-Superior
  John Phelan, Lake Superior Research Institute, UW-Superior

  In the spring of 2025, the University of Wisconsin's Lake Superior Research Institute will take delivery of the Sadie Ann, a custom-built vessel designed to support educators and researchers working in Western Lake Superior. For this networking session, LSRI staff will facilitate a discussion focused on the following questions:

  (1) How might the Sadie Ann support or help to expand current educational or research programs in the Twin Ports?
  (2) What unmet educational and research needs in the Twin Ports could be met or facilitated by the Sadie Ann?

(3) What structures are in place to publicize and coordinate use of educational and research vessel resources in the Twin Ports and how might they be improved?
(4) What near-term funding opportunities might be leveraged by a collaborative proposal for vessel use in the Twin Ports?

Outcomes of the session may include new or expanded partnerships to support current educational or research programs in the Twin Ports, opportunities to launch new programs that require vessel support that was previously not available, improved coordination of vessel resources in the Twin Ports, or new funding opportunities.

The Sadie Ann is a 65-foot, catamaran-style vessel with a diesel-electric, hybrid-drive propulsion system. The vessel, which has a draft of 4.6 feet, will have a maximum speed of approximately 18 knots and a cruising range of approximately 690 miles at 12 knots. It has a capacity of 49 passengers and 8 crew. The main deck of the Sadie Ann has a moon

pool, two water-level dive platforms, a davit, a 3,000-lb-capacity A-frame crane, winches, a dry lab, wet lab, and bathroom facilities. The second deck includes the pilothouse and a 300-square-foot multipurpose room with communication technologies. Heat and air conditioning throughout the vessel allow programs to be delivered in a range of weather conditions.

- **Cut & Paste – Creating Mosaics, Crossing Boundaries, & Making Connections** (YU Room 201)
  Rachel Portinga, Lake Superior Living Labs Network & Lakehead University

  Attendees will review the fundamentals of cross-boundary collaborations and be given the tools and resources to create a mosaic representing their boundary spanning work and connections in the St. Louis River watershed.

  Come chat with your work buddies while collaboratively creating a mosaic to visually show how you cross boundaries to bring together various "pieces" of disciplines, sectors, and places in service to the "whole" St. Louis River watershed. You'll discover who/what is missing from your mosaic and discuss what this means for the resilience of the St. Louis River watershed and its nested watersheds.

  Facilitated by the Lake Superior Living Labs Network, which uses the Lake Superior Watershed as the setting for engaging in research, teaching, and action projects that occur at various intersections of food, water, land, energy, climate, community wellbeing, and social justice.

- **Ecological Justice in the St. Louis River Estuary** (YU Room 204)
  Nicolette Slagle, Aalto University
  Leah Prussia, College of St. Scholastica

  This networking session will focus on exploring the concept of ecological justice, and what it means for the estuary and the communities that love it and live in it.

  The concept of ecological justice - a phrase with roots in the environmental justice movement - is grounded in the need for repairing relations between human and non-human community members. It is a process concerned with the recovery of an ecosystem and the relationship of the surrounding human (and non-human) communities to that ecosystem. It can also be a set of indicators used to assess the status of socio- ecological systems (SES), focusing on four dimensions of justice. Finally, it can be used as a guideline

for community-based sustainability work, focused on illuminating the connections to and reliance on the biosphere.

The session will consist of three parts:
1 - a brief introduction and overview of ecological justice as a concept and its application to the estuary.
2 - reflection and connection on relationships with the estuary.
3 - concept mapping of the estuary and selecting areas that reflect aspects of ecological justice.

The session will be used to recruit participants for a longer workshop in the future on the same theme outside of the summit.

- **Who is monitoring what in the St. Louis River Estuary in 2025?** (YU Great Room)
  Tom Hollenhorst, EPA Great Lakes Toxicology and Ecology Division
  Barb Huber, MN Pollution Control Agency
  Joel Hoffman, EPA Great Lakes Toxicology and Ecology Division
  Hannah Ramage, Lake Superior National Estuarine Research Reserve

  This networking session will provide time to discuss various planned monitoring and sampling in the St. Louis River Estuary. We are interested in hearing about everyone's plans and schedules as we approach the 2025 field season. We'd also like to hear about new projects or initiatives that are starting up this year, as well as new equipment, sensors, boats, and methods (including new methods) that might be employed.

  Hopefully, this will help identify potential areas of overlap or coordination that could make lives easier and put a bit less pressure on budgets. This session is meant to facilitate sharing this information and spur collaborations.

  We'll start the session summarizing what we have learned about monitoring efforts from previous years. We'll also compile the session notes from the 2025 session and share these with all the participants afterwards. Success will be marked by awareness of other projects overlapping by location/time/data set, developing an audience for a data set, or spurring on collaborations around specific sites or research/management questions.

THURSDAY MARCH 6, 2025

9:00 AM - Contaminants and Resilient Habitats (YU Great Room)

9:00 AM - Incorporating Habitat Use and Life History to Predict PCB Residues in St. Louis River estuary fish

Joel Hoffman*, US EPA Office of Research and Development
Tom Hollenhorst, US EPA Office of Research and Development
Greg Peterson, US EPA Office of Research and Development

Jon Launspach, General Dynamics Information Technology
Ellen Coffman, Wisconsin Department of Natural Resources
Lawrence Burkhard, US EPA Office of Research and Development

Owing to the varied distribution of contaminated sediments in the St. Louis River estuary, contaminant residues, such as polychlorinated biphenyls (PCBs), in fish tissue can vary widely. However, differences in fish life-history and habitat use can obscure the relationship between sediment and fish tissue concentrations.

To investigate the relationship between PCBs in fish tissue and heterogeneity of PCBs in sediment, we developed a geospatial Biota-Sediment Accumulation Factor (BSAF) model for the St. Louis River estuary. The model predicts whole fish total PCB residues at a scale of 0.1 km2 by incorporating information about sediment chemistry, fish home range, and habitat type. The model predicted concentrations from across the estuary ranging from 0 to 161,456 ng/g lipid. An estuary-wide (50+ km2) and a project-scale (1+ km2) field validation of the model demonstrated it produced values that were slightly skewed to low concentrations; performance improved with increased sediment data spatial coverage.

We demonstrate how this approach has potential for determining PCBs “hot spot,” estimating remediation project footprints, and evaluating potential remediation improvements to the quality of a fishery.

Keywords: contaminants, yellow perch, bioaccumulation

9:20 AM - Changes in methylmercury exposure to Common Tern chicks at a breeding colony in the St. Louis River Estuary (2016 - 2023)

Annie Bracey*, Natural Resources Research Institute
Sarah Janssen, USGS Mercury Research Laboratory
Joel Hoffman, US Environmental Protection Agency
Fred Strand, Wisconsin Department of Natural Resources (retired)
Morgann Gordon, US Environmental Protection Agency
Gaea Crozier, Minnesota Department of Natural Resources

Pollution of coastal waters from industrial contaminants, including heavy metals such as mercury (Hg), pose serious risk to human and wildlife health. Dietary exposure to methylmercury (MeHg), a potent neurotoxin, is widespread and because Hg in fish tissue exists primarily in a methylated form, MeHg risk can be directly associated with fish consumption.

Common Tern (Sterna hirundo) are globally distributed, colonial-nesting waterbirds, breeding in both inland and coastal regions of North America. Common Terns are largely piscivorous and therefore at high risk for dietary exposure to MeHg. Like other seabird species, they are useful indicators of environmental conditions.

There are two actively managed Common Tern nesting colonies on Lake Superior; Interstate Island in the St. Louis River Estuary (SLRE) and Ashland Island in Chequamegon Bay, Ashland, WI. In 2016 - 2017, we documented significantly higher concentrations of Hg in chicks hatched at the Interstate Island colony relative to Ashland Island, with concentrations increasing along the lake to river continuum and often exceeding toxicological risk thresholds.

In 2020, we used Hg stable isotopes (Δ199Hg vs. Δ202Hg) to identify the source of Hg exposure in chick feathers collected in 2016 - 2017. From this, we determined that Hg obtained from prey items in the SLRE were largely sediment-based in comparison to individuals feeding on lake-derived prey, suggesting that Hg from legacy sources was contributing to Hg exposure in fish and wildlife in the SLRE.

In 2023, we collected chick feathers from both colonies and determined that Hg concentrations were significantly lower in chicks at both colonies when compared to previous collections. We discuss how foraging location influences mercury exposure, how dynamic food web interactions can alter contaminant cycling, what lower concentrations may suggest for the future of the SLRE, and the importance of long-term monitoring of this species in the system to continue to assess risk post-restoration and Area of Concern delisting.

Keywords: mercury, wildlife, monitoring

9:40 AM - How do contaminants in the St. Louis River estuary affect the health of restored manoomin and those who eat it?

Gigi Diekelman*, UW-Madison, Lake Superior National Estuarine Research Reserve
Ashla Ojibway*, UW-Superior, Lake Superior National Estuarine Research Reserve
Deanna Erickson, Lake Superior National Estuarine Research Reserve
Jessica Hua, UW-Madison

Manoomin spiritually and physically sustains Anishinaabe peoples, thus, the preservation of Manoomin is also the preservation of Indigenous lifeways and identity.

In Chi-gami ziibi, the St. Louis River Estuary, climate change, non-local beings, dredging, water level fluctuation, and a long history of pollution from industrial activities caused significant losses to manoomin stands. Restoration efforts over the last decade in the estuary have aimed to protect, steward, and restore the manoomin that was once plentiful to support tribal health and food sovereignty.

As manoomin returns to the estuary, tribal communities have voiced interest in understanding more about this restored rice and whether it can uptake pollutants, such as heavy metals and PFAS, from the estuary and impact the health of manoomin and those who eat it. With input and knowledge from Tribal partners and community members, a research plan was developed by the UW-Madison Hua Lab and LSNERR to help address these concerns.

Keywords: Manoomin, community, restoration, health, contaminants

9:55 AM - Woodland Ave - Hartley Park Green Infrastructure Project

Tim Olson*, Bolton & Menk
Carol Andrews, Saint Louis County Public Works
Tom Johnson, City of Duluth

Tischer Creek watershed is one of 16 in Duluth that support naturally occurring Brook Trout. A substantial portion of the watershed is urban, resulting in water quality degradation issues. The Resiliency Report for Tischer Creek Watershed inventoried the stormwater system draining to Tischer Creek and identified

potential objectives to treat water from individual sub-watersheds. These objectives are identified and ranked in Duluth's recently completed Roadmap to Resilience (Roadmap) for Tischer Creek watershed.

One of the projects recommended in the RtoR is the newly constructed Woodland Ave/Hartley Park Green Infrastructure project. This large-scale green infrastructure, designed by Bolton & Menk, will improve water quality and aquatic habitat in Tischer Creek by treating runoff from 110-acres of residential and commercial development that flow into the Woodland Avenue storm sewer. This runoff previously discharged directly into the creek, which is listed as impaired for bacteria and has elevated levels of total suspended solids. The project will also help maintain cold baseflow to the creek and an associated tributary during drought conditions, restore pre-development hydrology and reduce "flashiness" that can cause stream bank erosion.

The project, constructed by St. Louis County on City property through a County-City partnership, has 212,000 CF of treatment capacity. A portion of the storm sewer under Woodland Avenue was reconstructed as part of a 2024 road project to divert runoff. After pre-treatment in a sedimentation vault near the road, runoff flows into a sedimentation basin and marsh followed by a series of bio-infiltration basins. The last basin includes biochar for bacteria removal. Basins and surrounding areas will be planted with native vegetation appropriate for the site. The project includes three years of vegetation maintenance and invasives control by a qualified contractor. In addition to providing land for the project, City of Duluth will be responsible for ongoing inspection and maintenance.

The project was able to move from an idea to reality thanks to several timely opportunities. This included availability of land, committed partners able to think outside the box, federal and state funding, and concurrent construction with the County's Woodland Avenue project.

Keywords: stormwater, green infrastructure, vegetation restoration, partnering

10:10-10:20 AM - BREAK

10:20 AM - Contaminants and Resilient Habitats (YU Great Room)

10:20 AM Featured Event – Climate Resilience is every day

Hosted by Lake Superior Reserve, with featured panelists:
Mindy Granley, Supervisor - Climate Assistance Unit, Minnesota Pollution Control Agency
Karola Dalen, Sustainability and Capital Planning Manager, St. Louis County
Dr. Natalie Chin, Climate and Tourism Outreach Specialist, Wisconsin Sea Grant

Embedding climate resilience into communities and the landscape is certainly a matter of innovative techniques and know-how, but it is also a mindset that takes opportunities to build resilience whenever they are available across the mosaic of infrastructure, community development, and landscape restoration along Lake Superior's shores. What can environmental professionals learn from organizations along the St. Louis River working to embed climate resilience into their every day work? How can we consider the built environment and natural spaces when imagining our resilient future? This discussion shares new, timely perspectives on creating a sustainable future across our region.

11:00-11:15 AM - BREAK

11:15 AM - Restoration in Focus (YU Great Room)

11:15 AM - Larval fish as indicators of St. Louis River estuary habitat quality and restoration effectiveness

Greg Peterson*, Environmental Protection Agency
Joel Hoffman, Environmental Protection Agency
Anett Trebitz, Environmental Protection Agency
Chelsea Hatzenbuhler, Spec Pro Services
Samantha Rumschlag, Environmental Protection Agency
Erik Pilgrim, Environmental Protection Agency

There currently is no fish based bioassessment metric for evaluating St. Louis River estuary (SLRE) site level habitat quality and restoration effectiveness. A contributing factor is that adult and juvenile fishes generally have home ranges much larger than the scale of concern; thus, it is difficult to quantify the localized effect of habitat degradation on fish abundance and composition.

Larval or young-of-year (YOY) fish, however, are less mobile, presumably more sensitive to environmental quality, and many species have specific spawning and nursery habitat requirements.

We describe past and future larval fish sampling efforts in the SLRE and discuss analytical efforts aimed at developing a sensitive indicator of localized habitat quality and restoration outcomes. Results indicate that larval fish community composition is influenced by multiple factors including vegetation type, year, and site. We discuss how the scales of analyses, interannual variability and survey design impact results and interpretation of restoration effectiveness.

Our preliminary conclusions are that larval fish are potentially a robust indicator of habitat functionality but not as robust an indicator of environmental quality.

Keywords: larval fish, habitat, restoration

11:35 AM - Allouez Bay Marsh Bird Habitat Restoration Update

Tom Prestby*, Audubon Great Lakes
Cherie Hagen, Wisconsin DNR

Audubon Great Lakes (AGL) and Wisconsin Department of Natural Resources (WDNR) are leading a project with approximately a dozen other partners to restore degraded habitat for marsh birds, fish, and other wildlife in Allouez Bay by managing invasive cattail and diversifying the structure of the large coastal wetland.

AGL and WDNR scoped the project and accepted a design with partner input, detailing several facets of this phase of restoration. Pre-restoration bathymetry and invasive cattail mapping, bird monitoring, and vegetation monitoring were conducted to establish baselines before restoration. 2024 was a busy year for

the project, as planning, mapping, and monitoring culminated into restoration construction. Project work featured cattail mowing and cutting and the collection of cut material, hemi-marsh excavation of pools and channels in invasive cattail stands, and native seeding.

We will provide a brief recap on how we got to this point and detailed updates on the progress of the project and lessons learned from construction that can be applied to other similar projects in the estuary. We will also discuss next steps for follow-up onsite work and post-restoration monitoring in 2025 and future years.

Keywords: restoration, Allouez Bay, marsh birds, hemi-marsh

11:50 PM - Substrate Environmental DNA for Detecting Fish Fauna in Comparison to Physical Surveys

Valerie Brady*, Natural Resources Research Institute, University of Minnesota Duluth
Jasmine Blomgren, Natural Resources Research Institute, University of Minnesota Duluth
Chan Lan Chun, Natural Resources Research Institute, University of Minnesota Duluth and Civil Engineering Department, University of Minnesota Duluth
Amber Ulseth, Natural Resources Research Institute, University of Minnesota Duluth
Josh Dumke, formerly Natural Resources Research Institute, University of Minnesota Duluth

Assessing fish populations plays a pivotal role in determining overall condition and biodiversity of many aquatic ecosystems. Monitoring fish diversity can provide valuable information such as rare species population size for threat categorization, monitoring for invasive species, range expansion of species, notes on habitat preference, and much more. Physical survey methods to assess fish communities, particularly netting and electrofishing, may damage the habitat or area of interest. This can make it hard to assess sensitive locations such as wild rice wetlands, a very sensitive habitat that holds cultural, economic, and historical significance to the Ojibwe tribes.

This study evaluates the efficacy of collecting substrate (rather than water) environmental DNA (eDNA) as an alternative to traditional assessment methods for determining the presence or absence of fish species in particular habitats.

For a proof-of-concept study, we compared trap netting catches to substrate eDNA detections in three wetland locations within the Saint Louis River Estuary in western Lake Superior: Radio Tower Bay, Spirit Lake, and Allouez Bay near the mouth of the Nemadji River. Fyke nets were set overnight in each location, and sediment samples were collected from the area near each net set just before net sets and after net pulls. Twenty target fish species were targeted for using PCR-gel electrophoresis and quantitative PCR analysis of mitochondrial cytochrome c oxidase 1 region.

Generally, detection of fish species by eDNA was comparable with catches for ubiquitous and not-expected species but did not detect fish present in low numbers in the nets. In addition, eDNA detected several species, sometimes with many detections, that were not physically caught. These results indicate that eDNA can complement physical surveys in fragile habitats. However, the interpretation of eDNA detections when none of that species was physically caught remains unclear with respect to habitat use by that species.

This leads to future studies such as comparison of these results to metabarcoding of substrate eDNA and development of eDNA use guidelines.

Keywords: eDNA, substrate, fish, wetlands

12:05 PM - Adjourn — transition to pre-registered optional Field Trips following.

1:30 PM - Optional Field Trips – held concurrently. Pre-registration is required.

1:30 PM Optional Field Trips (Concurrent)

- **Perch Lake Habitat Restoration Project Tour**
  Minnesota Department of Natural Resources

  The Perch Lake Habitat Restoration Project was completed as a necessary management action for the removal of BUI 9, Loss of Fish and Wildlife Habitat of the St. Louis River Area of Concern. Come out and see the elements of the project along with discussing the how's and why's of the final restoration project along with future recreational plans for the area.

- **Gibiskising minis Azhe-dibinaweziwin (Planning for the Restoration of Wisconsin Point)**
  Urban Ecosystems

  Gibiskising minis Azhe-dibinaweziwin (Planning for the Restoration of Wisconsin Point) is the result of a decades-long effort by the Fond du Lac Band to reclaim this land, which was taken from them by swindle in the early 1900s. The families that lived there were forced off the land, and the bodies of their ancestors were exhumed and reburied elsewhere in a mass grave.

  This project will create a Community Informed Design for the restoration and future stewardship of 12.74 acres of land regained by the Fond du Lac Band of Lake Superior Chippewa (Ojibwe). Located on Lake Superior's Gibiskising Minis (land bridge, Wisconsin Point), a bay-mouth bar complex across the mouth of Chi-gami ziibi (great sea river, St. Louis River); it is a site of tremendous ecological, cultural, and historic importance. Input from tribal and non-tribal land managers, archeologists, local government, tribal members, and tribal government will be incorporated into an Ecological Restoration & Monitoring Plan. This plan will account for the cultural significance of this place and strengthen the site against future human and natural disturbances.

  Join us for a facilitated discussion, where members of the Fond du Lac community and the design team share their thoughts, memories, and vision for the future of this place.

- **Putting the Voice of People in Your Projects - A Field Trip into the Landscape of Community**
  Minnesota Land Trust

  Journeying into the landscape of community can feel treacherous and scary. Come learn an approach for engaging community in conservation that will serve as your compass across this landscape. On this field trip into the heart of the Duluth/Superior community, you will become an action researcher.

Participatory Action Research is an approach that prioritizes the value of experiential lived knowledge of individual community members. This approach is a way to honor community knowledge and action as an integral part of conservation project planning, design, and implementation.
For this field trip, you will:
1. Gather at the meeting location to learn the Participatory Action Research approach.
2. Generate your own action research question.
3. Disperse into the local places that people work and play (e.g. grocery stores, coffee shops, libraries, even your own home!) to gather data on your research question.
4. Regather at the meeting location to share and discuss your research and explore the collective wisdom we gained about engaging communities authentically.

The data gathered will have real world application and will be added to the Headwaters Partnership online map to assist with establishing priorities for conservation.

- **Great Lakes Aquarium: Aquarium Exhibits are More than the Sum of Their Parts**
  Great Lakes Aquarium

  Great Lakes Aquarium is excited to host the St. Louis River Summit for a special behind-the-build exploration of Lava to Lakes, the newest exhibit opening in late spring of 2025! Join Executive Director, Jay Walker and members of the animal care and exhibit design teams as they share the exciting and complex exhibit design process, as well as what ventures lie ahead for Great Lakes Aquarium. The field trip will culminate with a behind-the-scenes tour of Aquarium systems.

POSTERS & ART SESSION - Tuesday March 4 from 4-6PM in the Yellowjacket Union Atrium

ART and ARTISTS

Mino-bimaadiziwin, Lauren Bortizke; Vidya Balasubramanyam, Coastal States Organization; Jothsna Harris, Change Narrative

Keywords: lifeways, Lake Superior, relatives

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SLR Mosaic, Kasey Banesh, Karin Kraemer, Tom Hollenhorst, Meera Ramakrishnan

Keywords: St. Louis River Estuary, community, engagement, sense of place

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Moonrise over the SLR, Alberta Marana

Keywords: appreciating the whole

—

2023 Storm Drain Art Project, 2023 Storm Drain Artists - Sylvia Houle, Dave Cook, Tom Moriarty, and Dawn, Mazie, and Molly Turchi; Charmaine Swan, Northwest Wisconsin Lung Health Alliance; Wisconsin Arts Board

Keywords: stormwater pollution prevention, local artists, protect Lake Superior

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Invasive plants in my backyard, Monica Ihrke

Keywords: flora, invasive, plants, printmaking, beauty

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Scientific Illustration of the Spiny Water Flea, Adam Frankiewicz, SpecPro Sustainment & Environmental

Keywords: invasive, invertebrate

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Winter Shoreline at Duluth Rose Garden, Adam Frankiewicz

Keywords: Duluth, Superior, winter, industrial

—

Storm Clouds Over Lake Superior, Adam Frankiewicz

Keywords: Duluth, clouds, Lake Superior

—

Canvas prints on easels from the SLR, Michael Anderson,Waankam Group: People of the Estuary

Keywords: waterways, woods

—

Microscopic Life in the Estuary, Becca Marston

Keywords: Cyanobacteria, microscopic, algae

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Lake Sturgeon of the SLR, Becca Marston

Keywords: Sturgeon, ceramics, estuary, wildlife, fish

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Drawing 1 - Black Ash Canopy, Kelly Beaster

Keywords: wetlands, estuary, forested, black ash, EAB

—

Drawing 2 - Fading, Kelly Beaster

Keywords: wetlands, estuary, forested, black ash, EAB

—

Ancient Forest - Magney-Snively, Kelly Beaster

Keywords: old growth, forest, mesic hardwoods, preservation

—

The SLR Estuary as Healing, Lynn Goerdt, Kennedy Fenster, UW-S and Live Well

Keywords: healing, water, land, spaces

—

Avian Night Sky Paintings and Poems: Protecting our Dark Starry Nights, Stephen Wilbers

Keywords: avian, night, migrations, dark, skies

POSTER PRESENTATIONS

1. Reducing The City of Duluth's Chloride Application to Protect Streams

Jake Mikna, City of Duluth (Minnesota Green Corps)
Mindy Granley, City of Duluth
Ryan Granlund, City of Duluth

Chloride is an emerging pollutant threatening the health of freshwater ecosystems, particularly in snow belt states with high levels of road salt application. The City of Duluth is currently working on writing a chloride reduction plan to outline strategies to reduce the application of road salt, the main source of chloride pollution in Duluth's impaired streams, which flow into the St. Louis River estuary and Lake Superior. Water samples were taken from several of the cities impaired streams during the snow season after road salt applications. Additionally, storm sewer outfalls along two sections of Arrowhead Road were tested to determine inputs of chloride into Tischer and Chester Creeks. This poster provides information on the chloride concentration data collected so far this season, hypotheses explaining certain trends, future steps the City might take to reduce chloride application, and the steps the City has taken to reduce its chloride use.

Keywords: chloride, salt, trout streams, road salt, sustainability

2. Characterizing Zooplankton Samples from GLISSNet: Using Morphological Analysis Alongside Metagenetics Data

Lana Franberg, University of Wisconsin-Superior, Lake Superior Research Institute
Clinton Arriola, Smithsonian Environmental Research Center
Kevin Mitchell, Smithsonian Environmental Research Center
Kristina Fleetwood, Smithsonian Environmental Research Center
Brenda Maria Soler Figueroa, Smithsonian Environmental Research Center
Jenna Hanlon, U.S Environmental Protection Agency, Research Triangle Park
Sarah Brown, U.S Environmental Protection Agency, Research Triangle Park
Andrew Chang, Smithsonian Environmental Research Center
John Darling, U.S Environmental Protection Agency, Research Triangle Park
Jon Geller, Moss Landing Marine Laboratories
Gregory Ruiz, Smithsonian Environmental Research Center

Zooplankton are small planktonic animals that are an important part of the aquatic food web, linking higher and lower trophic levels. These organisms can easily be overlooked due to their size. Morphological analysis using microscopy can detect species that may not be present in metagenetics reference libraries, whereas metagenetics may detect cryptic species as well as species that are present at densities below the level of detection for morphological analysis. These two analysis methods for the monitoring of introduced species complement each other. Together, these methods can help detect early introductions and broaden our knowledge of the zooplankton communities present in our waters. The Smithsonian Environmental Research Center has been collecting morphologic and metagenetics zooplankton samples in the Duluth-Superior Harbor since 2021 as part of the Great Lakes Introduced Species Sentinel Network Program. Morphological analysis is conducted at the Lake Superior Research Institute at the University of Wisconsin Superior. Metagenetic analysis is conducted at the US EPA, Research Triangle Park, NC.

Keywords: zooplankton, aquatic introduced species, morphological analysis, metagenetics

3. Using a non-invasive, molecular approach to determine sex ratios of Lake Sturgeon (Acipenser fulvescens) in the St. Louis River estuary

Noah Grode, Oak Ridge Institute of Science Education
Chelsea Hatzenbuhler, Spec Pro Services
Nick Bogyo, 1854 Treaty Authority
Loren Miller, Minnesota Department of Natural Resources
Dan Wilfond, Minnesota Department of Natural Resources
Courtney Larson, Environmental Protection Agency

Lake Sturgeon (Acipenser fulvescens) serve both a cultural and ecological role in many freshwater systems. In the St. Louis River estuary, Lake Sturgeon populations historically were extirpated due to habitat degradation, overfishing and contamination, and work to restore their populations is ongoing. Lake Sturgeon populations are hard to survey due to the species not reaching sexual maturity until later in life, and sexing in the field is a challenge as they cannot be differentiated based on physical differences other than by the expression of gametes. Recently a female-specific locus within the genome of six sturgeon species was identified, along with the subsequent identification of this region in Lake Sturgeon. This opened the door for the development of a molecular assay for determining the sex of sturgeons using non-invasive fin clip tissue and a qPCR-melt curve assay. In 2023 and 2024, the Minnesota Department of Natural Resources and the 1854 Treaty Authority collected 302 fin clips from Lake Sturgeons in the St. Louis River estuary. Currently the molecular sexing assay is being carried out to determine the sex ratio of this population. The sturgeon that have been molecularly sexed have been determined to be male. This is the first time this technique is being used in the St. Louis River estuary, and this work will aid in population models and management decisions. The views expressed in this presentation are those of the author(s) and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

Keywords: lake sturgeon, sex ratios, population models, qPCR

4. MPCA recommends removal of body contact restrictions at Munger Landing and Spirit Lake

LaRae Lehto, Minnesota Pollution Control Agency
Brad Leick, Minnesota Pollution Control Agency
Mark Elliott, Minnesota Pollution Control Agency
Dan Cervin, Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency (MPCA) has recommended the removal of body contact restrictions at Munger Landing and Spirit Lake in the St. Louis River. After many years of investigation, design work and construction, the Great Lakes Legacy Act remediation projects at the sites are complete. Legacy contamination at these sites resulted in impairments to both the environment and human health. Signs warning the public of the risk of exposure through bodily contact were posted at each site, and formal management actions to address the body contact restrictions were added to the St. Louis River Area of Concern Remedial Action Plan. Following completion of the remedial actions the MPCA conducted investigations at both sites, finding sediment remediation goals related to body contact have been met. In consultation with the Minnesota Department of Health, the MPCA determined these sites are once again

safe for public use. Institutional controls and a long-term monitoring and maintenance plan are required at Spirit Lake to manage contaminated sediments that remain on site in capped and recovering areas.

Keywords: remediation, Munger Landing, Spirit Lake, body contact, safety

5. High-Resolution Metagenomics Reveals Microbial Connectivity in the St. Louis River Estuary

Augustus Pendleton, Cornell University; Lake Superior National Estuarine Research Reserve
Kait Reinl, Lake Superior National Estuarine Research Reserve
Marian Schmidt, Cornell University

The St. Louis River Estuary is a vital ecosystem, serving as a fish and bird nursery, a key economic hub, and a culturally significant site for fishing, hunting, and wild rice harvesting. Its healthy functioning depends on the diversity, function, and stability of its aquatic microbial inhabitants, which are increasingly threatened by climate change, habitat destruction, and pollution. A recent indicator of microbial disruption is the rise of cyanobacterial harmful algal blooms in the estuary. To investigate these changes, I will employ long-read metagenomics to profile microbial communities across the estuary, from Oliver Bridge out to Allouez Bay. This approach will enable me to resolve the intra-population diversity of three types of bloom-forming cyanobacteria (Microcystis, Dolichospermum, and Aphanizomenon) and how microbial population connectivity influences biogeochemical cycling. The findings will identify “hot spots” for cyanobacterial growth and the environmental, hydrodynamic, and biological factors shaping these niches. These insights aim to guide actionable recommendations for state and tribal water managers. As I prepare to begin fieldwork this summer, I welcome feedback on my sampling and analysis plans from interested attendees.

Keywords: microbiology, cyanobacteria, sequencing, community ecology

6. Spatial and temporal distributions of protozoa in Lake Superior during 2022: The start of long-term monitoring

Leah Schleppenbach, Natural Resources Research Institute
Euan D. Reavie, Natural Resources Research Institute
Elizabeth E. Alexson, Natural Resources Research Institute
Holly A. Wellard Kelly, Natural Resources Research Institute

Protozoa, including amoeboid, flagellated, and ciliated protozoa, are important primary consumers that play a key role in Great Lakes food webs, however, assessments of their abundance, distribution, and composition are limited. Starting in 2022, we incorporated protozoa identification and enumeration into the US EPA Great Lakes Biology Monitoring Program, a long-term monitoring program aimed at assessing the health of the Great Lakes lower food webs. We collected samples from the R/V Lake Guardian at long-term monitoring stations across Lake Superior in spring and summer. We collected integrated (INT) water samples from the upper water column during both seasons; and deep chlorophyll layer (DCL) samples during the summer. Preliminary results indicate the presence of protozoa at 17 of the 19 stations, from 11 major groups of protozoa, including choanoflagellates and Ciliophora. Total protozoan biovolume was greater in summer than in spring, and greater in the DCL than INT samples. Continued monitoring of protozoa across the Great Lakes will allow a better understanding of the role these organisms play in the lower food web.

Keywords: Lake Superior, water quality, protozoa, long-term monitoring

7. Sulfate Remediation with Barite Precipitation Technology for Manoomin Waters

Daniel Wisniewski, Natural Resources Research Institute
Dr. Meijun Cai, Natural Resources Research Institute
Dr. Chan Lan Chun, Natural Resources Research Institute and University of Minnesota Duluth

Historically, northern Minnesota has supported vast amounts of Manoomin (wild rice). The Anishinaabe people consider Manoomin to be a sacred component of their creation story and is of great cultural and nutritional significance. However, the distribution of Manoomin today is significantly reduced compared to historical evidence, due to habitat loss and water quality degradation resulting from industrial development: mining, paper production, and logging. Sulfate is one of the potential pollutants that can affect the fitness of Manoomin. The Minnesota Pollution Control Agency (MPCA) has established a restrictive standard for sulfate of 10 mg/L in Manoomin waters. Existing technologies (e.g., reverse osmosis; ultrafiltration) can achieve this standard, but are expensive and generate significant waste products. The Natural Resources Research Institute (NRRI) has developed barite precipitation technology and expanded it to a pilot treatment system capable of operating at a flow rate of 1-2 gallons per minute. In the summer of 2023, pilot tests were conducted using effluent from the Western Lake Superior Sanitary District (WLSSD). The WLSSD effluent was transported to NRRI and pumped into the pilot system to assess the feasibility of sulfate removal, optimize operational parameters, and explore the potential for co-removal of phosphorus. Sulfate was successfully reduced from concentrations of 200-300 mg/L to 5-40 mg/L. Additionally, phosphorus levels were reduced from 5-12 mg/L to 0.4-2 mg/L, demonstrating the potential for simultaneous removal of both sulfate and phosphorus through this process. Building on the promising results from these tests and similar studies at other wastewater treatment facilities, the project team plans to collaborate with design firms to develop generic designs for implementing this technology in full-scale plant applications.

Keywords: Manoomin, water quality, sulfate, pilot system, chemical reaction

8. Investigation of Microplastic Buoyancy: Effects of Particle Characteristics in Controlled Density Separations

Angela Tippery, Large Lakes Observatory and Water Resources Science, University of Minnesota Duluth
Elizabeth C. Minor, Department of Chemistry and Biochemistry, University of Minnesota Duluth
Melissa Maurer-Jones, Department of Chemistry and Biochemistry, University of Minnesota Duluth

Microplastics, plastic particles smaller than 5 mm, have emerged as a significant environmental concern due to their growing abundance and potential adverse effects on aquatic ecosystems and human health. They have been found in St. Louis River estuary harbor surface waters and in both surface and deep waters in Lake Superior. This study aims to enhance understanding of microplastic behavior (floating vs sinking) in aquatic systems, improve laboratory separations of microplastics from natural matrices, and contribute to strategies for mitigating plastic pollution. Known standards with particle properties varying in polymer, morphology, and size were put in three solutions of varying density (MilliQ water, saturated NaCl solution, saturated $CaCl_2$ solution). These were performed to investigate the role of solution density and ionic strength in microplastic floating vs sinking behavior. Further, density separations are a common processing step in microplastic studies so this will inform improved methods for handling microplastic samples. It was hypothesized that larger, denser particles will have a greater abundance in the lower portion of the density separations in the lab. Statistical analyses, including Kruskal and Dunns tests, permutation-based MANOVA,

and principal component analysis were used to assess relationships between microplastic characteristics and vertical displacement. The results revealed that particle size had the greatest influence on particle abundance and spatial distribution within the various density solutions, with significant differences also observed across polymer types. Heatmap analyses indicated that $CaCl_2$, a higher-density solution, did not promote greater particle buoyancy; instead polyvinylidene chloride and polyethylene terephthalate were preferentially found in the pellet at greater numbers than in the other solutions. These findings suggest that material properties (particle size and polymer composition) play a crucial role in determining particle buoyancy in aquatic systems. They show that direct density comparisons among solutions and polymer types cannot clearly predict the depth within the density fractionations where the particles can be found. These insights are important in highlighting the potential "blindspots" in microplastics sample preparation and analysis in systems, like the St. Louis River estuary, where the natural organic matter and clay components of water samples need to be removed before microplastics analysis using microFTIR.

Keywords: microplastics, density separation, buoyancy, particle size, polymer composition

9. Evaluating Post-Restoration Erosion and Streambank Stability Under Various Vegetation and Flow Conditions

David Lang, University of Minnesota Duluth
Elizabeth Prindle, Iowa State University
Karen Gran, University of Minnesota Duluth

Stream restoration is a common and costly practice amongst natural resource managers. While restoration objectives are diverse, erosion mitigation is typically one of several motivations underpinning such projects, as excessive erosion jeopardizes the new channel and has detrimental impacts for water quality. Despite this, the impacts of restoration on streambank stability, particularly the removal of vegetation during full-channel realignment projects, are poorly understood. This study seeks to model streambank stability as vegetation reestablishes at three fully realigned reaches in and near Duluth, MN. The Bank Stability and Toe Erosion Model (BSTEM) is being utilized to model several selected reaches under different flood magnitudes and varying root reinforcement conditions. Each realigned reach in this study has a corresponding control reach. Root counts were performed at the control reaches, and these data are being used as a reference for modelling root reinforcement under a mature riparian community. Factor of safety results will first be compared across the different model runs to determine whether changing root reinforcement meaningfully impacts streambank stability. The factors of safety will then be analyzed as flood frequencies increase to determine if there is a threshold flood magnitude at which the streambanks are at risk of excessive erosion. To compare model results with erosion, unmanned aerial vehicle and total station surveys were performed at each reach. These will be compared to as-built surveys conducted immediately after the realignment occurred to quantify erosion and deposition at each reach, with results compared to the model outputs. Reaches with very low factors of safety should show the greatest erosion risk, while those with higher factors of safety should have experienced lower erosion since the installation of the project. These results will act as a case study and will seek to answer whether the act of restoration at these specific locations is exposing the channels to excessive instability during high flow events. Because many projections in the Upper Midwest suggest increasing flood magnitudes due to climate change, these case studies can help to highlight the need for restoration practitioners to consider stream resilience in their design.

Keywords: stream restoration, erosion, geomorphology, riparian vegetation

10. Community Codes & Ordinances: Powerful Tools for Protecting our Waters

Madison Rodman, University of Minnesota Sea Grant
Tiffany Sprague, University of Minnesota Natural Resources Research Institute

Green stormwater infrastructure (GSI) can help improve water quality and reduce flooding, but specific language in local land-use codes and ordinances can unintentionally prohibit or discourage the implementation of many of these practices. Often, language in local codes and ordinances, and norms around site planning practices, contribute to ongoing problems with water quality. Municipalities may desire to move green infrastructure forward, but may be stymied by code language, and in less populous communities, volunteer boards likely do not have the capacity or expertise to evaluate current codes, develop new ones, and shepherd these changes through the amendment process. To support our local communities in increasing adoption of green infrastructure, and other practices that benefit water quality, Minnesota Sea Grant and NRRI have collaborated with communities along Lake Superior's North Shore to develop a framework allowing for, and promoting, the adoption and installation of green infrastructure to address water quality and quantity concerns. We'll share with you the lessons learned - what is going well, what needs these communities still have, and how you can get involved - from our time working with the City of Duluth, Midway Township, St. Louis County, Lake County, Cook County and Grand Marais.

Keywords: green infrastructure, regulations, water quality

11. HABs in the St. Louis River Estuary: the last two years helps guide a future monitoring plan

Euan Reavie, Natural Resources Research Institute, University of Minnesota Duluth
Peter Birschbach, Natural Resources Research Institute, University of Minnesota Duluth
Hannah Ramage, Lake Superior National Estuarine Research Reserve
Christopher Filstrup, Natural Resources Research Institute, University of Minnesota Duluth

Though Lake Superior's St. Louis River Estuary (SLRE) is set for delisting as an Area of Concern, contemporary stressors on ecosystem condition remain a concern. Recent cyanobacterial blooms in the SLRE point to emerging stressors to the functioning and health of the estuary. We conducted research to track water quality, algal community shifts, harmful algal blooms (HABs), and hypoxia. Sampling involved high-frequency collections at eight locations throughout the SLRE, selected for spatial variability and potential bloom susceptibility, to characterize nutrient and phytoplankton community dynamics. Data analysis was focused on identifying drivers of blooms and refining the locations and frequency of sampling needed to form the foundation for a long-term, collaborative SLRE monitoring program. We will present new findings related to stoichiometric conditions underlying the formation of HABs, including the occurrence of an unprecedented, toxic bloom in 2023. Spatial and temporal heterogeneity in water quality and phytoplankton will also be discussed, with recommendations for future monitoring strategies. This work will allow us and our project partners to identify and address emerging water quality concerns into the post-delisting future.

Keywords: algal blooms, water quality, monitoring, cyanobacteria, algae

12. New Taxa Records of Macroinvertebrates within Lakes Erie, Michigan and Superior Watersheds

Gerald Shepard, SpecPro Sustainment & Environment

Frankiewicz Adam, SpecPro Sustainment & Environment
Schmude Kurt, Lake Superior Research Institute

The purpose of this poster is to present eight previously undocumented taxa from samples collected around the Great Lakes between 2004 and 2023. The authors have provided taxonomic services for a variety of biomonitoring surveys via contract with US EPA, and/or various state agencies (MPCA, WI DNR, etc). Two of these taxa are non-indigenous to North America, while the others represent possible native range extensions. We found five taxa from the St. Louis River Estuary (SLRE - Lake Superior) including: three species of fish lice - Argulus appendiculosa (also found from Chequamegon Bay - Lake Superior), Argulus longicaudatus, and Argulus stizostethii); the eastern pondmussel (Sagittunio nasutus); and the freshwater goblet worm (Urnatella gracilis). Additionally, the non-indigenous European ear snail (Radix auricularia) was identified in samples collected from Newton Creek, a tributary to the SLRE. The SLRE continues to behave as an AIS hotspot. From the Manistique River (Lake Michigan) we confirmed the presence of the flatheaded mayfly (Maccaffertium mexicanum integrum). Lasty, we identified a non-indigenous midge, Polypedilum nubifer, from Otter Creek (Ohio), which flows into Lake Erie. All taxa have been verified by a second taxonomist. Except for the fish lice that were found throughout the SLRE, and Polypedilum nubifer that were detected within partitioned samples, all other taxa were found in low densities in localized distributions, suggesting early stages of establishment and spread.

Keywords: macroinvertebrate, new, invasive, Superior, Erie

13. Effects of a Sediment Microbiome Amendment on Geochemistry and Microbial Community Composition for Wild Rice Restoration

Britta Larson, University of Minnesota Duluth, Natural Resources Research Institute
Nathan W. Johnson, University of Minnesota Duluth
Chan Lan Chun, University of Minnesota Duluth, Natural Resources Research Institute
Kelly Duhn, University of Minnesota Duluth, Natural Resources Research Institute

Wild rice populations have been declining in the St. Louis River and the Great Lakes Region, and current restoration strategies have mixed results. This study explored using a microbial augmentation as a possible novel restoration technique for wild rice. We attempted to elucidate whether nutrients required for growth could be released from sediment for plant uptake with a microbial augmentation through a single plant microcosm study. Results suggested that the wild rice plants did not recruit distinctive microbes from the augmentation (donor sediment) to their roots, but organic C breakdown was increased, allowing for the release of extra P and N to porewater. This excess nutrient availability did not result in larger plants or alter the nutrient content of seeds, suggesting a possible further N limitation since the increased P availability did not result in more rapid or robust growth. A microbial augmentation approach, upon further investigation, could be a minimally invasive and sustainable technique to assist in providing nutrients for wild rice plants.

Keywords: microbial, nutrient, restoration, wild rice

14. How does wildfire severity affect mercury mobilization and bioaccumulation in Minnesota's wilderness lakes?

Christopher Filstrup, Natural Resources Research Institute, University of Minnesota Duluth
Nicholas Bogyo, 1854 Treaty Authority

Jennifer Brentrup, Minnesota Pollution Control Agency
Chan Lan Chun, Natural Resources Research Institute, University of Minnesota Duluth
Jerald Henneck, Natural Resources Research Institute, University of Minnesota Duluth
Sarah Janssen, U.S. Geological Survey, Mercury Research Laboratory
Randall Kolka, USDA Forest Service Northern Research Station
Britta Larson, Natural Resources Research Institute, University of Minnesota Duluth
Stephen Sebestyen, USDA Forest Service Northern Research Station
Michael Tate, U.S. Geological Survey, Mercury Research Laboratory

Minnesota's iconic wilderness lakes provide vital ecosystem services (e.g., fisheries, manoomin) and important recreational opportunities, but are increasingly threatened by emerging stressors related to climate change. One often overlooked consequence of climate change in Minnesota is wildfires, which are anticipated to become more frequent and severe with warmer and drier conditions. Using the 2021 Greenwood Fire near Isabella, MN as a test case, we showed that lakes within burned watersheds had elevated nutrients, sediment loads, and dissolved organic carbon compared to unburned watersheds. These changes in water quality persisted for three years after the fire. Although wildfires are suspected to mobilize mercury transport to lakes, it is unclear if post-wildfire water quality conditions lead to higher methylmercury concentrations in lakes and if wildfire-derived mercury can bioaccumulate in fish. Beginning Summer 2025, we will collect water and sediment samples from lakes within the Greenwood Fire burn zone that have been monitored since the fire to examine water quality, levels of mercury and methylmercury, and microbial communities associated with mercury methylation. To fully evaluate how wildfires affect mercury mobilization and bioaccumulation in fish, we will measure mercury and methylmercury concentrations in water, surface sediments, and fish tissue in a subset of lakes (16 total) categorized as high burn severity and control (8 lakes each). Molecular approaches will be used to identify which microorganisms in the water and surface sediments are directly and indirectly responsible for mercury cycling (methylation, demethylation genes) to better understand what conditions contribute to increased methylmercury production and bioaccumulation in lakes. This presentation will provide an introduction to our project with the hopes of increasing our stakeholder community and receiving feedback on project design.

Keywords: bioaccumulation, lakes, mercury, nutrients, wildfires

15. Everyone Can Bird

Natalie Chin, Wisconsin Sea Grant

Since 2022, local partners, including the Lake Superior National Estuarine Research Reserve, Friends of the Lake Superior National Estuarine Research Reserve, Hawk Ridge Bird Observatory, Minnesota Land Trust, Wisconsin Sea Grant, the cities of Duluth and Superior, and indiGO, have been collaboratively organizing the "Everyone Can Bird" event series. These free events are designed with access in mind and invite attendees of all ages, disabilities and abilities, and bird observation experience to enjoy the great birding opportunities that we have around the St. Louis River Estuary and Lake Superior. We provide several features to reduce barriers to participation, including ASL interpretation, binoculars, portable seating, and free bus transportation. We've seen a steady increase in participation in these events over the last three years, from one event with 11 attendees in 2022 to 3 events with a total of 130 attendees in 2024, and have received very favorable evaluation responses. We want to share information about these events with Summit attendees and invite new partners to join us as we start planning for 2025.

Keywords: community engagement, accessibility, birding

16. Assessing the Perceptions of Environmental Restoration through Aesthetics Monitoring

Jules Witts, US Environmental Protection Agency
Dr. Meghan Klasic, US Environmental Protection Agency
Dr. Kathleen Williams, US Environmental Protection Agency

The Great Lakes Water Quality Agreement (GLWQA) identifies degradation of aesthetics as one of the beneficial uses of the ecosystem that should be restored. Degraded aesthetics, such as odors and debris, can leave a negative impact on the local community through decreased recreation opportunities and a diminished aesthetic value. According to the GLWQA, aesthetics are degraded when either "an objectionable deposit or unnatural color or odor" is present. In Areas of Concern, the objectionable deposits are most often oil slicks, odors, or trash and are attributes easily recognizable to both resource managers and citizens. Using the observation and classification of aesthetics as a boundary concept between resource managers and citizens may enhance the ecological and social benefits of environmental restoration through a more defined and shared understanding of how people perceive their environment. Using aesthetics as a method for documenting how people perceive the environment is critical as citizens may characterize impairments differently than resource managers do. As a result, state agencies and local government decisions may be influenced by the application of aesthetics monitoring. This presentation is a status report and will share how United States Environmental Protection Agency (USEPA) is documenting aesthetics and environmental change at Pickle Pond in Superior, WI and other sites around the Great Lakes. We will share preliminary data to describe the process and implementation of aesthetics monitoring. We expect this study to become a longitudinal study of place, as well as a potential model for a crowdsourcing platform.

Keywords: aesthetics, boundary work, well-being, water quality

17. Allouez Bay Marsh Bird Habitat Restoration - Construction Phase

Tom Prestby, Audubon Great Lakes
Cherie Hagen, Wisconsin Department of Natural Resources
Rob Peterson, GEI
Andy Hinickle, Audubon Great Lakes

The Allouez Bay wetland complex is a crucial coastal wetland for many species of declining birds, fish, and other wildlife. While there is still a diverse community of native plants and wildlife, this wetland is being degraded by non-native species, including invasive cattail (Typha angustifolia and Typha x glauca). Audubon Great Lakes (AGL) and Wisconsin Department of Natural Resources (WDNR) are leading a project with approximately a dozen other partners to restore degraded habitat for marsh birds, fish, and other wildlife in Allouez Bay by managing invasive cattail and diversifying the structure of the large coastal wetland to increase hemi-marsh conditions. Hemi-marsh construction included the creation of a network of interconnected channels, pools, mounds of varying height and shape, and mimic muskrat dens. After providing design for the project, GEI Consultants coordinated mowing and hand-cutting of invasive cattail in targeted areas, and hemi-marsh construction in 2024. These major restoration actions were completed late in 2024 and will provide a reference for restoration in large Great Lakes coastal wetlands using these methodologies. The poster will feature updated ground-level and drone photos showcasing the 2024 restorations, and discuss lessons learned and next steps for the project, including vegetation and avian monitoring.

Keywords: Marsh birds, Allouez Bay, restoration, hemi-marsh

18. From genes to ecosystems: building environmental genomic capacity at NRRI

Andrew Wood, Natural Resources Research Institute
Dr. Chan Lan Chun, Natural Resources Research Institute
Dr. Valerie Brady, Natural Resources Research Institute
Dr. Annie Bracey, Natural Resources Research Institute
Britta Larson, Natural Resources Research Institute
Jasmine Blomgren, Natural Resources Research Institute

Everything living in the Saint Louis River Estuary (SLRE) sheds genetic material into its environment. Any environmental or biological sample you can imagine - water, tissue, soil, feces - can yield genetic materials like DNA and RNA. By decoding these genetic materials using sequencing and other molecular methods, we can address a wide range of biological questions pertaining to ecosystem health and function in the SLRE. Invasive species can be detected by sequencing DNA from water samples; routes of exposure to toxic mercury in bird populations can be revealed by characterizing avian diets using fecal DNA; and increasingly frequent algal blooms can be monitored for toxin-producing microbes. These are just a few examples of how DNA sequencing can address pressing issues in the SLRE and help piece together its complex mosaic. Unfortunately, sequencing and subsequent data analysis are too often intimidating or inaccessible to practitioners who would benefit most from the insights they offer. To solve this problem, the Natural Resources Research Institute is building capacity for onsite DNA sequencing and environmental genomic analysis. Our goal is to deliver practical, outcome-focused tools and expertise to researchers and managers that will facilitate actionable scientific findings in alignment with our institutional mission: to find sustainable solutions for issues facing Minnesota's environmental resources. Here, we outline several projects focused on proof-of-concept and method development. These include an avian fecal metabarcoding study to track dietary mercury exposure, an aquatic invasive species monitoring study, and a study characterizing microbial community composition in Lake Superior sediments. We also describe our initial operating capacity and present a long-term vision for developing these capabilities further. Our goals at this summit are to 1) share what we are doing with the SLRE scientific community, 2) learn how we can tailor our future efforts to meet the research needs of this community, and 3) have conversations with potential partners who might be interested in collaborations.

Keywords: eDNA, sequencing, genomics, ecosystem health

19. Monitoring for the Future: Post AOC Water Quality in the St. Louis River Estuary

Jesse Anderson, Minnesota Pollution Control Agency
Dan Breneman, Minnesota Pollution Control Agency
Hannah Nicklay, Lake Superior National Estuarine Research Reserve
Kait Reinl, Lake Superior National Estuarine Research Reserve

As the St. Louis River AOC program moves closer to a 2030 delisting, MPCA's Environmental Analysis and Outcomes (EAO) Division is collaborating with the Lake Superior National Estuarine Research Reserve (NERR) on a long-term strategy for monitoring water quality in the estuary. The Poster details how MPCA

will monitor the estuary throughout the 2025-2026 field season to assess Aquatic Life and Aquatic Recreation Uses, and report results to US EPA and area partners.

Keywords: water quality, monitoring, MPCA, NERR

20. Uncovering connections between forest fire smoke and harmful algal blooms

Bridget Beyer, Oak Ridge Associated Universities
Terri Jicha, U.S. Environmental Protection Agency
Kasey Benesh, Oak Ridge Institute for Science and Education

In 2023, Minnesota set a record for experiencing the highest number of air quality alerts in a season (Minnesota Pollution Control Agency). The record-setting alerts originated from smoke plumes driven by Canadian wildfire activity. This led to thousands of people being exposed to high levels of fine particulate matter (PM 2.5), volatile organic contaminants (VOCs), and ozone. That same season, the St. Louis River Estuary experienced numerous cyanobacterial harmful algal blooms (HABs) that contained cyanotoxins. Previous studies have shown that mobilized wildfire smoke and its chemical constituents can affect downwind HAB formation in other systems, including freshwater lakes in the western U.S. This, in turn, can impact human health in ways beyond the creation of respiratory distress. Our preliminary data exploration suggests that similar dynamics can take place in the St. Louis Estuary and along the southern shore of Lake Superior. We explored several public data sets, including MPCA Air Quality Index, the National Atmospheric Deposition Program (NADP), the Community Multiscale Air Quality Monitoring System (CMAQ), and Lake Superior bloom reports to evaluate trends and identify data gaps pertaining to air and water quality monitoring. On average, blooms appeared within 7.8 days of moderate or high Air Quality Index (AQI) events. Additional field data can be collected, paired, and interpolated with currently available data to bridge knowledge gaps, as well as enhance the mechanistic understanding of the relationship between water chemistry parameters, physical environmental parameters, and spatial and temporal distributions of HAB events.

Keywords: wildfire smoke, harmful algal blooms, air quality, nutrients

21. Evaluating the Effectiveness of Manoomin Hulls as Mulch

Simon Councillor, Fond du Lac Tribal and Community College Environmental Institute
Steven Gebhard, Fond du Lac Tribal and Community College Environmental Institute
Kelsey Myhre, Fond du Lac Tribal and Community College Environmental Institute
Erica Resendiz-Alonso, Fond du Lac Tribal and Community College Environmental Institute

Manoomin (wild rice) holds significant cultural and societal importance to the Anishinaabe people. Manoomin hulls are typically a byproduct of the ricing process following the parching and winnowing of the rice. The producers on the Gitigaaning farm have begun using hulls as mulch, but little is known about the effectiveness of the hulls as mulch. This project explored the effectiveness of using wild rice hulls as mulch. Six raised beds were established in a high tunnel to simulate a semi-controlled environment. The beds were divided into three groups: two with one inch of wild rice hulls, two with two inches, and two with no mulch. To simulate drought, half of the beds were watered regularly, while the others were reduced by 30% of irrigation. Continuous monitoring sensors collected hourly soil temperature and soil moisture data. Soil moisture was collected daily using discrete soil moisture probes to assess soil moisture distribution of the

soil beds. Abiotic conditions including humidity levels, temperature, wind speed and wind direction were measured every 15 minutes from a weather station. Initial analysis shows that beds mulched with wild rice hulls retained higher soil moisture levels, particularly under reduced irrigation. Soil moisture distribution was more uniform in mulched beds, as indicated by LabQuest readings across different areas. Biomass production and plant counts were significantly lower in beds with 2 inches of mulch compared to the control, suggesting improved growing conditions. This poster assesses the impact of rice hull mulch on soil moisture retention and weed growth. We aim to provide practical agricultural insights for improving crop resilience. Future plans involve further analysis of the data to refine recommendations on rice hull mulch usage and potential applications in community gardens and larger-scale agricultural practices.

Keywords: wild rice, rice hull research

22. Patterns in Community Engagement and Social Science Literature in the Great Lakes Areas of Concern Program

Meera Ramakrishnan, United States Environmental Protection Agency
Kathleen Williams, U.S. Environmental Protection Agency
Meghan Klasic, U.S. Environmental Protection Agency
Megan Baumann, U.S. Environmental Protection Agency
Brittany Kiessling, U.S. Environmental Protection Agency

Community engagement research strategies, which includes the use of public participation and Public Advisory Councils (PACs) models, centers building trust and relationships with community members to enhance environmental cleanup by reducing conflict and increasing public satisfaction. Assessing the use of PACs as part of the Great Lakes Areas of Concern (AOC) program can serve as a common model to better understand the dynamics of participation and engagement; such as why some community participatory groups work better than others. Because of increased interest in engaging affected communities in the Great Lakes region environmental remediation and restoration, the team conducted an extensive literature review examining Great Lakes social science-based research about PACs, community participation, local governance, benefits of restoration, and community revitalization. The literature review covers works published since the start of AOC in 1987. An initial screening identified over 100 studies including journal articles, graduate student projects and theses, and governmental reports pulled from databases such as Web of Science, ProQuest, and Google Scholar. Preliminary data findings suggest that there are significant hotspots in both author connectivity and geographic distribution of research surrounding specific AOC sites, which may influence engagement in these sites. Using this data, the team intends to generate a framework to explain elements of successful PACs and other organizations. *The views expressed in this presentation are those of the author(s) and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

Keywords: community engagement, Great Lakes, literature, participation, environment

23. Biological Factors Influencing Mercury Cycling in the St. Louis River Watershed

Hailey Anderson, Fond du Lac Tribal and Community College
Andrew Wold, Fond du Lac Tribal and Community College
Chan Lan Chun, Natural Resources Research Institute
Katie Edblad, Natural Resources Research Institute

Methylmercury is a neurotoxin that can lead to adverse health effects in humans. Starting in 2017, FDLTCC and collaborators have investigated impacts of mercury in the St. Louis River watershed by measuring total and methylmercury (MeHg) concentration in Odonates and surface water samples across the three landscape types: forested, wetland, and ditched peatland. We found that in the ditched peatland and wetland sites, the bioaccumulation factor (BAF) of MeHg increased with increased dissolved organic carbon (DOC). Other studies have found that BAF decreases with increasing DOC, but we observed this only within our forested landscape study sites. We hypothesized that the microbial communities in sediment may be responsible for driving these differences given their mercury methylation capacities at different environmental conditions. In an effort to see what may be driving these differences, we have investigated the microbial communities in sediment across the three landscape types, and quantified populations harboring a mercury methylation gene (HgcA) and sulfur transformation genes (dsrA and soxB) using quantitative PCR. Preliminary results will be discussed in relation to the previous findings to understand environmental and biological drivers on methylmercury bioaccumulation.

Keywords: mercury, microbial, water, sediment

24. Assessing the resiliency of Lake Superior coastal wetlands to climate change

Mike Smale, Wisconsin Sea Grant
Madeline Magee, Wisconsin Department of Natural Resources
Cherie Hagen, Wisconsin Department of Natural Resources

Great Lakes coastal wetlands are diverse and dynamic ecosystems that have developed to function under disturbances at the interface of terrestrial and aquatic systems. Climate change is projected to alter these disturbances outside their historical ranges, subjecting coastal wetlands to warmer temperatures, more extreme precipitation events, larger fluctuations in lake levels, and increased wind and wave action. These anticipated changes pose an uncertain risk to coastal wetland habitats and are therefore challenging for natural resource managers who have limited resources for wetland management, preservation, and adaptation efforts. Using Lake Superior as a pilot, we have developed a climate change vulnerability assessment framework to estimate the relative sensitivity of Great Lakes coastal wetland habitats to the anticipated effects of climate change. Data from the Coastal Wetlands Monitoring Program (CWMP) and state databases (e.g. Wisconsin National Heritage Inventory, Wisconsin Wetland Inventory) are used in conjunction with published literature and the expert opinion of regional and state-wide wetland professionals to assign sensitivity, adaptive capacity, and resiliency scores to each wetland. Rankings for 38 coastal wetlands in the Lake Superior basin of Wisconsin, 10 of which are within the St. Louis Estuary, will be shared. These estimates of wetland sensitivity and resiliency help inform the application of adaptation tactics and may assist in the prioritization of management efforts and distribution of limited funds in the Lake Superior basin, which can then be replicated on other Great Lakes systems.

Keywords: climate change, Great Lakes, coastal wetlands, vulnerability assessment framework

25. Long-term trends in mercury concentrations in waterbodies and fish in the St. Louis River watershed

Jennifer Brentrup, Minnesota Pollution Control Agency

The St. Louis River watershed is a unique ecosystem that supports many important services including fishing, recreation, and commerce. The Minnesota Pollution Control Agency (MPCA) is developing a total maximum daily load (TMDL) study to reduce mercury concentrations in the St. Louis River watershed. Mercury pollution has prevented many water bodies from meeting water quality standards that support healthy consumption of fish. As part of the study, the MPCA compiled long-term data on mercury concentrations in water bodies and three dominant fish species. The goal for this presentation is to share trends in mercury concentrations in water and fish tissue throughout the watershed and estuary. Mercury concentrations were generally higher in the mainstem of the river followed by other tributary rivers and streams, while methylmercury concentrations were generally highest in lakes and reservoirs. Compared to other major rivers in Minnesota, the St. Louis River had the second highest mercury concentrations just behind the Red River. However, long-term monitoring on the St. Louis River below the Scanlon dam has shown a significant decrease in surface water mercury and methylmercury concentrations over the past decade, especially in the spring and summer. Using two decades of fish data, we found that fish tissue mercury concentrations were highest in the lakes and reservoirs, particularly for channel catfish and walleye, while northern pike concentrations were highest in the St. Louis River and tributaries. Significant mercury reductions will be needed for many water bodies to meet water quality standards, and the TMDL report will discuss implementation strategies.

Keywords: mercury, fish, long-term data

26. Adaptive restoration and understory plantings in black ash wetlands of the St. Louis River Estuary

Kirsten Rhude, Lake Superior National Estuarine Research Reserve
Deanna Erickson, Lake Superior National Estuarine Research Reserve

Black ash (Fraxinus nigra) are abundant along the St. Louis River Estuary and the Lake Superior coast. These ash dominated wetlands and the habitat they provide are changing rapidly due to the invasion of Emerald ash borer (EAB) which reached the St. Louis River Estuary in 2013. Since 2023, The Lake Superior National Estuarine Research Reserve (Reserve) has been working with the Wisconsin Department of Natural Resources and Wisconsin Conservation Corps to plant 40,000 tree seedlings in an effort to maintain some of these sites as forested wetlands into the future. Seventeen target replacement tree species were selected based on site conditions, projected future climate scenarios, and cultural uses and traditions these species support. In 2023 thirteen species were planted including northern white cedar (Thuja occidentalis), swamp white oak (Quercus bicolor), river birch (Betula nigra), silver maple (Acer saccharinum), northern hackberry (Celtis occidentalis), red maple (Acer rubrum), tamarack (Larix laricina), black spruce (Picea mariana), American basswood (Tilia americana), cottonwood (Populus deltoides), sugar maple (Acer saccharum), white pine (Pinus strobus) and white spruce (Picea glauca). The Reserve has planted three monitoring plots with seven of each replacement species to observe mortality and growth rate of these plantings over time. Monitoring the survival and growth rate at these monitoring plots should help identify promising species to incorporate into other restoration efforts in coastal ash dominated wetlands.

Keywords: restoration, black ash, invasive species

27. Five Years of Non-Native Species Control on Clough Island; Light at the End of the Tunnel

Dara Fillmore, Wisconsin Department of Natural Resources

Five years ago, Clough Island (in Superior) had dense buckthorn, honeysuckle and barberry throughout much of its 351 acres. Through funding from a Great Lakes Restoration Initiative (GLRI) grant, most of the island went from 85-95% buckthorn density down to ~15%. Dara Fillmore from Wisconsin DNR will share the methods used to lower the density and the first steps being taken for long-term restoration, with an interest in future project ideas from the audience to continue natural community improvements on the island.

Keywords: buckthorn, honeysuckle, invasive control

28. Developing a Habitat Map of the St. Louis River Estuary

Howard Veregin, Wisconsin State Cartographer's Office
Kirsten Rhude, Lake Superior National Estuarine Research Reserve
Jeffery Thompson, U-Spatial
Olena Boiko, U-Spatial
Carol Reschke, Independent Consultant
Kelly Beaster, Independent Consultant
Kristi Nixon, Natural Resources Research Institute
Carl Sack, Fond du Lac Tribal and Community College
Ann Buschhaus, State Cartographer's Office
Chris Susnik, University of Wisconsin-Superior
Valerie Ross Zhaawendaagozikwe, University of Wisconsin-Superior

Over the last 18 months, a team from Wisconsin and Minnesota has been working to complete a habitat map of the St. Louis River estuary, with funding from NOAA's National Estuarine Research Reserve System (NERRS) Science Collaborative. The project team includes staff from the Lake Superior National Estuarine Research Reserve, Wisconsin State Cartographer's Office, U-Spatial at the University of Minnesota, the Natural Resources Research Institute at the University of Minnesota-Duluth, and several independent consultants.

The project is applying mapping techniques to the 57,000 acres of wetlands and adjacent uplands within a mile of the lower 21 miles of the St. Louis River below the Fond du Lac dam. The goal is to support estuary-wide habitat restoration planning and vulnerability assessment. The project responds directly to the needs of the St. Louis River Habitat Workgroup, a coalition of agencies, local government units, communities, and individuals who have been working on implementing their vision since writing of the 2002 Habitat Plan. The workgroup is updating the 2002 Habitat Plan for the estuary, which is needed to guide future habitat conservation (restoration, enhancement and protection) of the lower St. Louis River and parts of its watershed in northeastern Minnesota and northwestern Wisconsin.
The project transfers knowledge and experience from an earlier habitat mapping project within the boundaries of the Lake Superior Reserve. The team used image classification methods–including machine learning classifiers and freely available, non-proprietary data–to create a reproducible approach that can be adopted in other locations and redeployed at regular intervals to illuminate change over time. An additional product from the project is a change analysis report comparing habitat maps from 2002 (the date of the latest habitat map of the estuary) to analyze important habitat shifts over the last two decades.

Keywords: habitat, mapping, restoration, conservation, GIS

29. Minnesota Pollution Control Agency (MPCA) Biological Monitoring Program

Murphy Steininger, Minnesota Pollution Control Agency (MPCA)

The Minnesota Pollution Control Agency (MPCA) conducts biological monitoring on fish and aquatic macroinvertebrate communities on rivers and streams throughout the state of Minnesota. The state is divided into 80 watersheds, each of which is sampled every 10 years. Furthermore, a network of long term biological monitoring stations are sampled every two years at roughly 60 locations statewide. Monitoring data from watersheds within the Lake Superior basin, and particularly results from the St. Louis River, Nemadji River, and Cloquet River watersheds will be displayed. Biological monitoring results are quantified utilizing indices of biological integrity (IBI's). These IBI scores are numeric values which allow MPCA biologists to assess the condition of rivers and streams throughout the state, ultimately contributing to the Environmental Protection Agency's impaired waters list. This poster will provide an in depth look at recent work in the St. Louis River watershed as well as neighboring watersheds and will shed insight into the mechanics of IBI tools.

Keywords: biological monitoring, MPCA, water quality, impaired waters

30. Harmful Algal Bloom Identification Training for Water Professionals

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As cyanobacterial blooms—commonly known as blue-green algae—become more frequent in the St. Louis River estuary and Lake Superior's nearshore, concerns around toxicity and health risks are growing. The 'Harmful Algal Bloom (HAB) Identification Training for Water Professionals' is a new training opportunity presented by the Lake Superior NERR in partnership with the Minnesota Sea Grant program taking place on May 22, 2025. The objective of this training is to help participants gain knowledge about cyanobacterial blooms and learn skills in HAB detection. Specifically, participants will learn and practice field methods to detect cyanobacteria and differentiate them from non-HAB phenomena, gain familiarity with basic microscopy techniques for common cyanobacteria identification, and explore algal toxin testing with hands-on instruction using various toxin rapid test kits, supported by recent research findings. The goal of this training is to equip attendees with the skills and tools necessary to enhance waterfront monitoring, public safety, communication, and stewardship efforts.